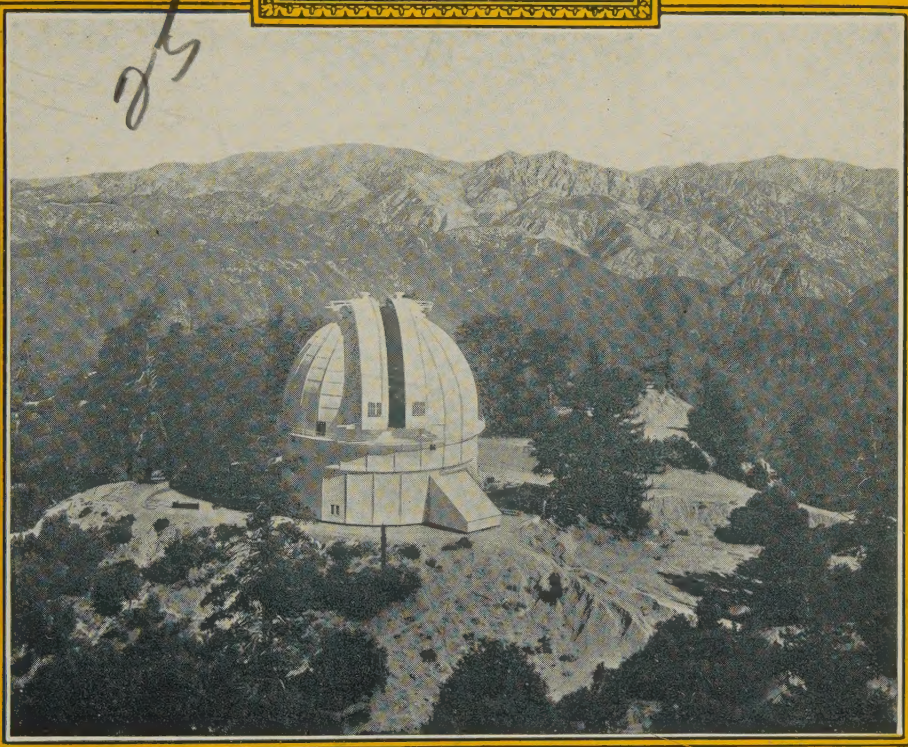
THE MENTOR

October 1921



Mount Wilson, where important astronomical work is done. This is one of the observatory domes

NEW MARVELS OF ASTRONOMY

By Garrett P. Serviss

Moon and Weather
Man Measures Milky Way
A Comet That Comes Back
The Bank of England Wakes Up
Modern Art and "Isms"
He Thought for Others
Our First Law School

TRANSFERRED JAN 1997

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or

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How about Shantung and Pacific mandates and "foreign spots" in China?

Do you want to pay your share of a ten billion dollar international navy bill in the next ten years?

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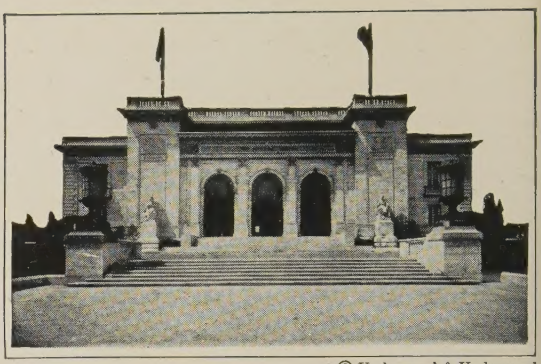

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The Pan American Building in Washington, where the Disarmament Conference will probably be held.

Contents of October Asia

The Loveliest Lady in China.....*By L. Adams Beck*

"She must die!" cried the revolutionary army that marched against Ming Huang, Emperor of China. And like another Du Barry, the exquisite Kwei-fei paid the terrible penalty for having been loved by a great Ruler. The old golden days at Versailles pale in comparison with the effulgent court life at Ch'ang-an, where Ming Huang lavished the wealth of the Orient upon this Chinese girl.

The President of the Far Eastern Republic
By H. V. V. Fay

Not long ago there lived in Chicago a lawyer named Tobelson. At the time of the Kerensky revolution in Russia he disappeared. Today, official messages coming out of Siberia from the headquarters of the new Far Eastern Republic—a section of Siberia stretching from Lake Baikal to Kamchatka—are signed by the President, Krasnostchokoff. Krasnostchokoff and Tobelson are one. Here is a thrilling chapter of history.

Off Duty in Bagdad.....*By Roland Gorbold*

Mr. Gorbold was an officer in the Mesopotamian Expeditionary Force, and knows his Bagdad in peace and war. His delightfully human impressions give a new color to the coffee-shops, the bazars, and the teeming narrow streets of this ancient city.

Rough Weather in the Paumotus..*By Frederick O'Brien*

Again we sail with this romancer of the South Seas, and this time escape with him the thrilling peril of a water-spout that seems to link heaven and earth in a narrow column.

The Terraced Road of the Two-Edged Sword Mountain.....*By Li-Y'ai-Po*

English version by Amy Lowell

A Chinese poem rendered into English verse by Amy Lowell is always an event in literary circles. This one holds all the exquisiteness of old China.

The Philippines Before Magellan....*By H. Otley Beyer*

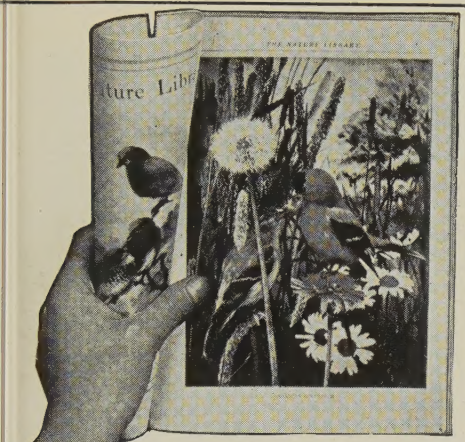
The first of a series of important articles dealing with sources of Malay civilization before the beginning of Spanish history on these islands.

Sun-Child.....*By Genevieve Taggard*

The whimsical experience of a little girl in Hawaii who makes intimate friends with nature—a little girl that Barrie would have loved.

My Apprentice-days in Persia.....*By Youel B. Mirza*

Picturesque reminiscences of a Persian youth who started life in a village carpenter's shop and afterwards in America became a student of Johns Hopkins University.



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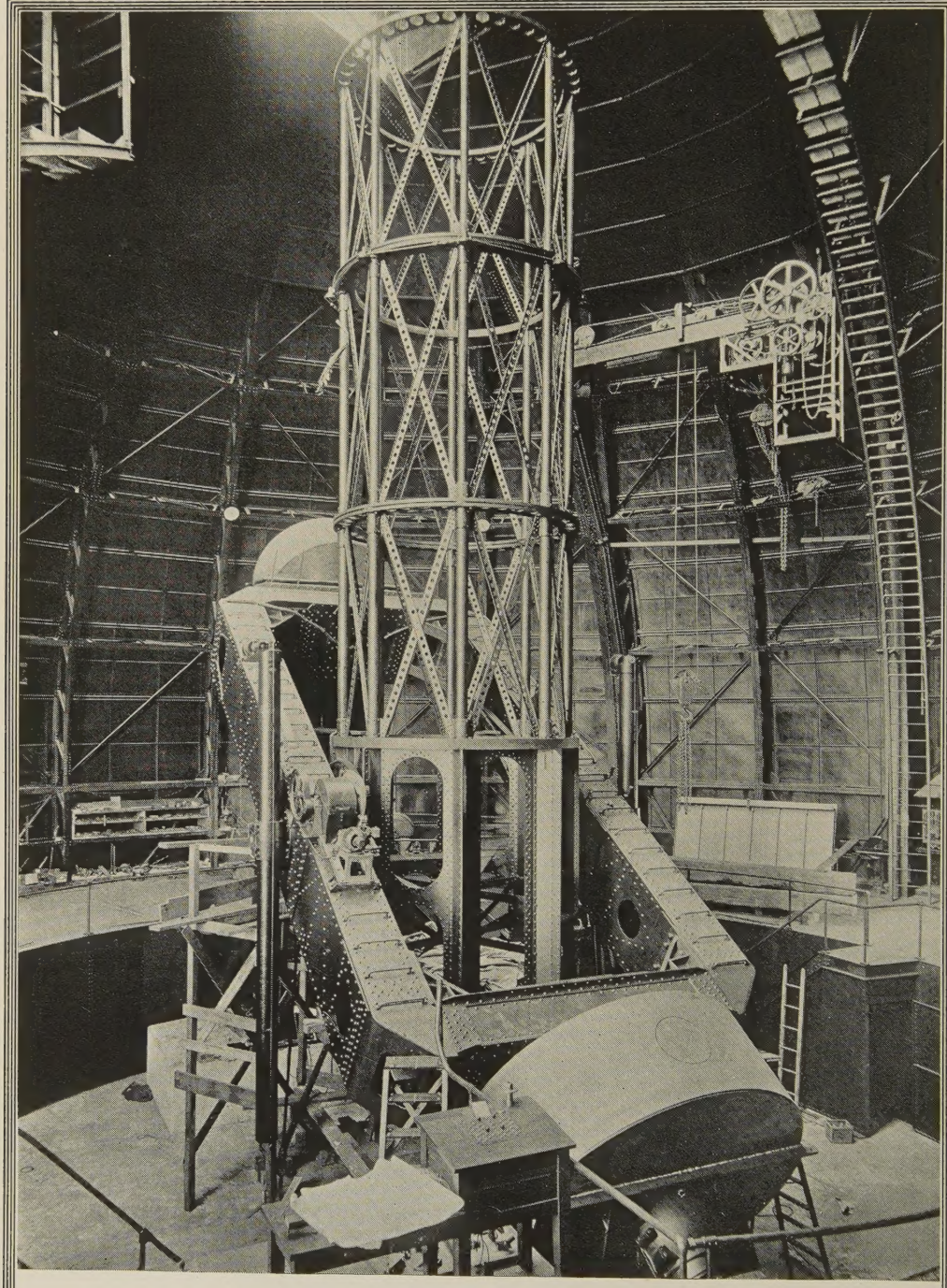

The King of Reflecting Telescopes

Mt. Wilson Solar Observatory, California. This giant mirror—101 inches in diameter—has revealed hidden marvels of the sky and betrayed to students of the celestial highways hitherto unsuspected secrets

THE MENTOR

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THE LATEST MARVELS OF ASTRONOMY

By GARRETT P. SERVISS

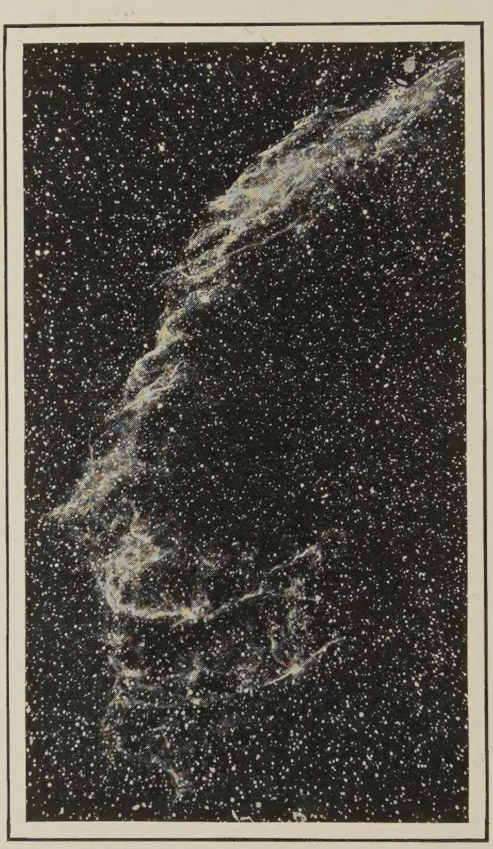
IT IS the purpose of this article to point out the nature and extent of the startling and almost revolutionary discoveries that have been made within the last few years.

Let us begin with a brief statement of what was, until but yesterday, the generally accepted view of the structure and dimensions of the starry universe of which our solar system forms a very minute part.

The first important attempts to learn the construction of the heavens and to fathom the star depths were those of Sir William Herschel, who died a century ago. Everybody knows that strangely impressive feature of the night sky, called the Milky Way, or the Galaxy, which surrounds the entire firmament, and, in moonless midsummer night, illuminates with a lambent nebulous light, like the phosphorescence of the ocean, the southern part of the sky, from the beautiful Northern Cross and the glittering Eagle overhead down to the star gems of Scorpio and Sagittarius just on the horizon. This "highroad to Jove's court," which even Galileo's telescope had shown to be sprinkled with stars as thick as dust, Herschel regarded as indicating, by the effect of perspective, the plane of a vast stellar stratum of which our sun is a member, though situated somewhat aside from the center.

Herschel's first impression was that the stars were nearly uniformly scattered throughout the supposed flat stratum, somewhat like the flakes in a steady snowfall. If such a snowfall were confined to a long, narrow vertical stratum, an eye looking out of it from somewhere near the middle would see the flakes thinly scattered when the view ranged out through the sides, but densely crowded when the eye followed the long axis. It was found, however, that this supposition did not correspond with the

details of the Milky Way, such as its subdivision into minor streams and offshoots, its rifts and vacancies, its dense, cloud-like masses, etc. Accordingly, while the opinion continued to be held that the stars, as a whole, are contained in a region of space shaped like a flat disk, or a broad, relatively thin lens, whose central plane coincided with that of the Milky Way, yet the Milky Way itself came to be considered as a ring, or garland, of clustering stars surrounding, afar off, the part of space where we dwell. Another description of the Milky Way is that of a complicated, and partly broken, spiral, composed of millions of stars, encircling us at a great distance, our sun being situated among a scattered cluster of nearer stars in the midst of the relatively open space within the ring, or spiral. This whole system, including both the Milky Way and the stars within its circle, as well as any stars that may lie beyond that circle, was, and is, regarded as having the flattened, or disk-like, shape already mentioned.



Photographed at Yerkes Observatory, October, 1901

A Cloud of Glowing Vapor

Known to scientists as a nebula. There are uncounted thousands of these gaseous scarfs flung across the heavens

There is another great general fact, long known to astronomers, which we must consider.

In addition to the stars—all of which are suns more or less like our sun—we now have to take into account the existence of other objects. First, the nebulæ, of which there are two widely divergent classes. One class, the first discovered, consists of faintly glowing cloudlike phenomena which the spectroscope reveals as incandescent gaseous masses of enormous size, whose most characteristic component appears to be a strange element, unknown on the earth or in the sun, that imparts a greenish tinge to their light, and called, because it is found only in them, "nebulium."

Another class consists of even more wonderful objects, the so-called spiral nebulæ, whose shapes are suggestive of half-wound-up springs, whirling fireworks, luminous maelstroms, bursting flywheels, and other forms associated with the effects of centrifugal force. These have been known in large numbers only since the opening of the present century, and particularly since the application of photography, on an ever-increasing scale of success, in astronomical investigations. The spiral nebulæ differ fundamentally from the other class, since their spectra indicate that they are not composed of incandescent gas,

but that their substance is intermingled, perhaps, with gases, partly solid or liquid, so that they may, really, consist of stars in various stages of development. Their distances are very great.

There is yet another, and still different, class of celestial objects that play an extraordinary rôle in the universe—the "globular star-clusters." A globular star-cluster consists of a compact-looking swarm of giant suns, perhaps a million in number, thousands of which individually exceed our sun from one hundred to one thousand times in actual brightness, while the distance of the cluster is so immense that all of its members blend their light into a hazy speck, often so faint as to be barely visible even with the largest telescopes. As in the case of the nebulæ, most of our knowledge of these great sun-clusters is due to photography.

Photographed at Mount Wilson Observatory, April, 1910

A Globular Star-Cluster

Lying outside, but distinctly related to the Milky Way

Now, all of these various objects—the stars composing the Milky Way together with the stellar system that surrounds our sun inside the Milky Way; the nebulæ; and the globular star-clusters—are found to be very significantly arranged with respect to one another. They universally obey some great law of relationship which subordinates them to the galactic plane—that is, the middle plane of the Milky Way—which serves as a sort of central framework for the whole system. But this does not mean that these different classes of objects all lie in, or close to, that plane. Far from that being the case, it is the stars only that crowd into the galactic stratum, while the spiral nebulæ, and possibly also the globular star-clusters, keep out of it, and generally far away on both sides of the plane. The gaseous nebulæ, however, are more closely associated with the stars.

Photographed at Mount Wilson Observatory, August, 1910

A Remarkable Photograph of a Nebula in Spiral Form

Little was known of these phenomena until the camera came to the aid of the telescope

We now turn to the new views of

the universe, with their suggestions of illimitable distances, appalling velocities, mysterious movements, that seem co-related, and wonderful transformations under control of forces, the nature of some of which can only be guessed at, while their combination presents to the imagination a picture, fascinating through its impression of the working of some grand law of the cosmos, hitherto undreamed of, and still no more than glimpsed in its effects.

Photographed at Mount Wilson Observatory, November, 1916

Nebula—Presumably Spiral. Photographed edge-on

Many of these views are the result of work and study centered at the Mount Wilson Observatory in California, whose unrivaled collection of powerful instruments of observation together with its remarkable staff of investigators, reinforced opportunely by co-laborers from other observatories, has placed it at the forefront of contemporary astronomical advance. What follows is based largely upon papers published at various dates from 1917 to 1921 by Dr. Harlow Shapley (now of the Harvard Observatory); but he is in no way responsible for the form in which the subject is here presented.

In the first place, the old ideas about the dimensions and boundaries of the starry universe have lately been expanded to an almost incredible extent. This is due to novel methods of determining the distances of celestial objects. Until the other day astronomers were dependent for their knowledge of celestial distances upon the method used by the surveyor on the earth, who first measures a base line, then takes sights upon a distant object alternately from the opposite ends of the line, carefully ascertains the angles which the two lines of sight make with the base, and from these data, by a simple trigonometrical rule, calculates the distance of the object.

Right here let us introduce, and once for all define, an important astronomical term, "Parallax." The parallax of a distant object is the angle between the two sight lines of the surveyor where they meet at the object. If you know that angle, together with the length of the base, the distance of the object falls into your outstretched hand like an apple from a shaken branch.

Now this is the angle that the astronomer tries to measure when seeking to learn the distance of a star, and in order to have the angle of a measurable size he must take an enormously long base line. Nature furnishes this by the annual revolution of the earth around the sun. The opposite ends of a diameter of the earth's orbit are 186,000,000 miles apart, and the astronomer, without any trouble to himself, is carried from one end to the other of that diameter every six months. In principle then, all that he has to do is to take two looks at his star, six months apart, and the shift of the star on the background of the heavens, caused by

his change of place in space, gives him the parallax angle.

This trigonometric method is still the surest in its results for stars whose distance does not exceed a few trillions of miles, but the vast majority of the stars are so remote that their parallactic angles are too minute for trustworthy measurement.

This means that the gigantic base-line span of 186,000,000 miles is virtually nothing in comparison with the distance stretching between such stars and the earth. Although the principle of parallax was understood in ancient times, yet the first actual measurement of a stellar parallax occurred less than a hundred years ago, and until within a few years past, there were only about a hundred stars whose parallaxes had been even approximately ascertained. As lately as 1914, the English astronomer, Eddington, affirmed that, in all, probably not more than two thousand stars were near enough to afford a practically measurable parallax. He set the limit of such a parallax at 0.05″ (five hundredths of a second of arc), which would correspond to a distance of about four hundred trillions of miles.

But now, through other methods, we have parallaxes based on *millionths* of a second of arc—in one case only, 0.000015″, corresponding to a distance of more than 1,260 thousand trillions of miles. This particular object, as we shall see later, happens to be a globular star-cluster.

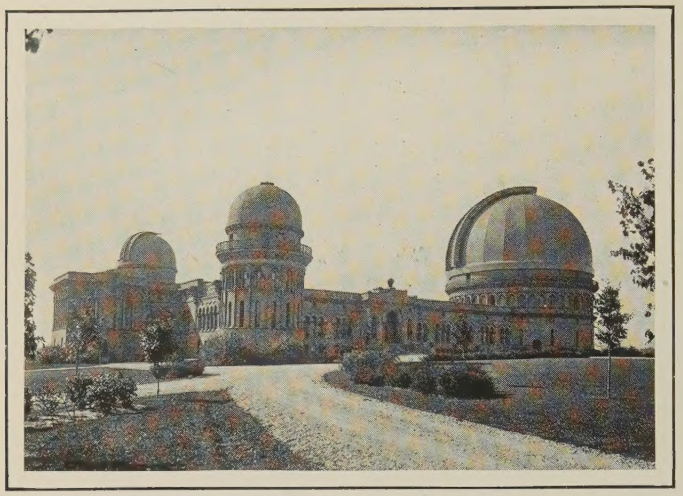
Photographed at Mount Wilson Observatory, June, 1910

A Nebula Like This is Millions of Times Larger Than the Earth

As an example of the newer methods, a correlation has been found between the absolute magnitudes and the relative intensities of the lines in the spectra of certain types of stars, which affords a means of calculating their distances. The absolute magnitude of a star is the brightness that it would have if seen from a distance corresponding to a parallax of 0.1″ (one tenth of a second of arc). At that distance our sun would be of magnitude 4.7″, that is, a small naked-eye star; but there are thousands of stars in the globular clusters, besides many separate ones, of absolute magnitude 0, or greater—the equal of seventy-five suns or more—and a star of absolute magnitude 5 exceeds the sun about 7,600 times.

The apparent, or angular, diameter of a celestial object is correlated with its distance, and if, as appears to be the case with globular clusters, a whole class of objects have very nearly the same actual diameter, while the apparent diameters vary inversely with distance, then the relative distance of each object of the class can be gauged by measuring its angular diameter.

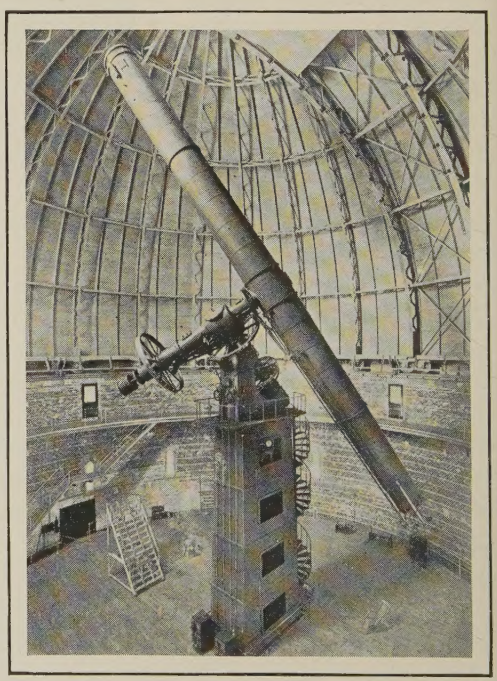
A lively interest has lately been excited in this matter of stellar dimensions by the success at Mount Wilson of Prof. Michelson's interferometer method in measuring the apparent diameter of the bright star



Yerkes Observatory, Williams Bay, Wisconsin
Where very important astronomical work is done—especially in stellar photography

Betelgeuse in Orion, and thence deducing its real diameter in miles. What was done in this case was simply to apply, in a refined manner, and with exceedingly delicate special apparatus, the same principle that a surveyor would use to get the size of a distant inaccessible object. He would measure the angle between the lines of sight drawn from his eye to opposite ends or sides of the object. That would give him the angular diameter, and he could immediately translate this into actual diameter if he knew his distance from the object. The Mount Wilson measure showed that *Betelgeuse* has an angular diameter of 0.047″. Its parallax was already known to be 0.018″, corresponding to a distance of about 1,055 trillions of miles. Now, by the rules of circular measure, an object having an angular diameter of 0.047″ must be at a distance about 4,388,000 times its actual diameter; so, dividing 1,055,000,000,000,000 by 4,388,000, we get, in round numbers, 240,000,000 miles *as the diameter of Betelgeuse*. This giant star has nearly the same diameter as the orbit of the planet Mars around the sun!

It is now known with practical certainty that the size of the sidereal system is at least a *thousand times greater* than it has hitherto been supposed to be. Still retaining the idea of a more or less flattened, or disk-like, shape for the whole, it has been shown that, in its longest dimensions, the vast system of the stars, in which our sun, and indeed our entire solar system, is as a speck of dust, has an extension of not less, and perhaps much more, than 100,000 *parsecs**, or say 325,000 light-years. These figures depend upon measurements and calculations

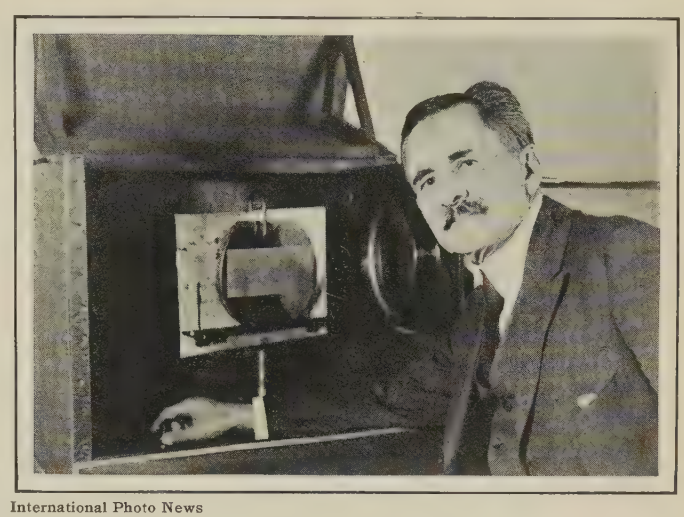


The Forty-Inch Refracting Telescope
Yerkes Observatory, Williams Bay, Wisconsin. Built in 1897. It has never been surpassed

*Parsec is a comparatively new astronomical unit of measurement whose equivalent in miles is 19,182,000,000,000, or in round numbers 19 trillions. It is the distance corresponding to a parallax of one second of arc (1″). Light-year is an older term expressing the distance that light travels in the course of one year. This distance is, in round numbers, 5,860,000,000,000 miles.

whose results are probably trustworthy to a high degree of approximation. But beyond them go estimates, not similarly verified, which place the possible distance of some celestial objects at millions of light-years!

But let us consider only the figures that may be relied on. They are sufficiently astonishing. The most distant object, as far as known at present, is the globular star-cluster N. G. C. 7006. The letters "N. G. C." mean New General Catalogue, and the figures following express the number of the object in that catalogue. It is the same object mentioned a little way back as having a parallax of 15 millionths of a second, corresponding to a distance of 1,260 thousand trillion (or 1,260 quadrillion) miles. One cannot form the least idea of so stupendous a distance as that without approaching its consideration by graduated steps. First try to get at it in this way: The distance of the sun is 93,000,000 miles. That, enormous though it be in comparison with distances on and around the earth, is comprehensible. We are used to such figures as millions and even thousands of millions. But now consider this: the distance of the globular star-cluster N. G. C. 7006 is more than thirteen and a half thousand million times greater than the distance of the sun! Or attack it in another way, which will appeal to the imagination of those who are used to dealing with numbers and their squares—who know, for instance, that an income tax of $100,000 if simply squared would become $10,000,000,000. But, if you square the sun's distance of 93,000,000 miles, you will get a number *less than one 145th part of the distance* of the globular star-cluster N. G. C. 7006! Look at it in another aspect, that of the time required to traverse such a distance. If you could take flight on a cannon-ball traveling half a mile per second, you would be nearly six years in going from the earth to the



International Photo News

Professor Albert A. Michelson

Seated before one of the instruments similar to those used in measuring the diameters of stars trillions of miles from the earth

Lick Observatory

Founded by James Lick. It occupies a mountain top near San José, California. Its 36-inch telescope was completed in 1888

sun. But to keep on until you reached N. G. C. 7006 would require *eighty billion years*. Even light, which travels 5,860 billion miles in a year, would take more than 215,000 years in making that journey! If a giant could stride one step from the earth to the sun he would have to make thirteen and a half billion such steps in going to N. G. C. 7006. A man could walk around the earth on a great circle with 44,000,000 three-foot strides, while the giant would have to make more than 300 times that number of *ninety-three-million-mile strides* in order to reach his goal!

The Snow Horizontal Telescope Building

This structure contains a great horizontal telescope specially designed for studies of the light of the sun. It was given to the Yerkes Observatory by Miss Snow twenty or more years ago, and later was located at the Mount Wilson Observatory, California

There are other globular clusters almost equally remote. In short, the globular clusters, as a class, are by far the most remote of all objects in the universe, with the possible exception of the mysterious spiral nebulæ, of which we shall speak a little later.

And then the size of these clusters is as gigantic as their distance. There are good reasons for thinking that all of them have nearly the same linear dimensions. According to Harlow Shapley, the cluster known as Messier 13 (this is the famous cluster in Hercules) has a diameter of 450 light-years, or more than two and a half quadrillion miles, and contains probably more than 50,000 stars intrinsically brighter than our sun, while all of the stars that appear ordinarily on its photographs are individually more than 200 times as bright as the sun. The total number of stars in this cluster, as in others of the globular type, cannot be counted, because of their increasing density toward the center, but reasonable estimates show that there must be hundreds of thousands and possibly a million of them, the most of which are giants compared with the sun. But now again we come to something still more astonishing.

We have seen that the globular clusters are not found in the Milky Way, or the galactic stratum, but far away from it on each side of its median plane, both above and below that plane, that is, north and south of it.

This avoidance is, in itself, very remarkable, for why should these great dense star-clusters appear to keep away from the region where the other stars are assembled in hundreds of millions? Are they really absent, or are they hiding behind distant nebulous clouds? But that is only the beginning of the enigma. Perhaps the most startling discovery is that the globular star-clusters are swiftly moving—one is tempted to say plunging—from both sides, toward the galactic plane, where the stars abound. When the investigators first found

this out, I imagine, they could not trust their own results, but must have worked the data over and over again, so unexpected and incredible seemed the conclusion to which they were led.

But that conclusion became more strange the further it was followed. It will be well here to quote a few sentences from Harlow Shapley:

The present evidence suggests that globular clusters as a class may be falling rapidly into the regions rich in stars. There appears to be no very obvious or reasonable escape from the conclusion that some clusters at least are destined to enter the mid-galactic region. With such great velocities and masses it seems incredible that clusters would not easily pass through the stratum of stars. Further observations may reveal survivors receding from the galactic plane, and we may be able to examine them for the effects of the passage. There is, however, suggestive though incomplete evidence that globular clusters are gradually dissolved in the mid-galactic regions. As a general but not infallible rule the clusters at moderate or high distances from the galaxy are compact; the nearer ones are open. The distribution of stars in open galactic clusters is possibly a second indication of the gradual dissipation of globular clusters in the Milky Way.

In connection with this it is suggested that the famous group of stars called the Pleiades (Tennyson's "swarm of fire-flies") may be a relic of a great globular cluster which ages ago plunged down into the galactic segment and was, so to speak, torn to pieces, its smaller stars being dissipated "under stresses such as those prevailing in the galactic region."

In view of such amazing conclusions one cannot help wondering about the ancient history and "the most disastrous chances" of our little sun, brought in, perhaps, as an inferior member of a mighty globular horde from the far desert stretches of ethereal space to the glittering crowds of the galactic segment, and there flung off and lost in the throng of strangers, most of them equally alien in origin.

As to the nature of the forces concerned in these strange shaping processes by virtue of which the universe is still evolving, the best light as yet available is furnished by another quotation from Shapley:

As a provisional working hypothesis, which is supported by numerous observed conditions, and may be further tested without difficulty, it is suggested that the obvious dynamical equilibrium of a globular cluster has been acquired originally at a great distance from external perturbing forces and is an extremely delicate adjustment that breaks down under stresses such as those prevailing in the galactic region; further, that faint stars in globular clusters are of small mass and of more than average velocity, and in their orbital motions frequently attain great distances from the center. When the globular cluster approaches a disturbing body as massive as the general galactic system such stars are of course most easily lost and intermingled with galactic stars. On the other

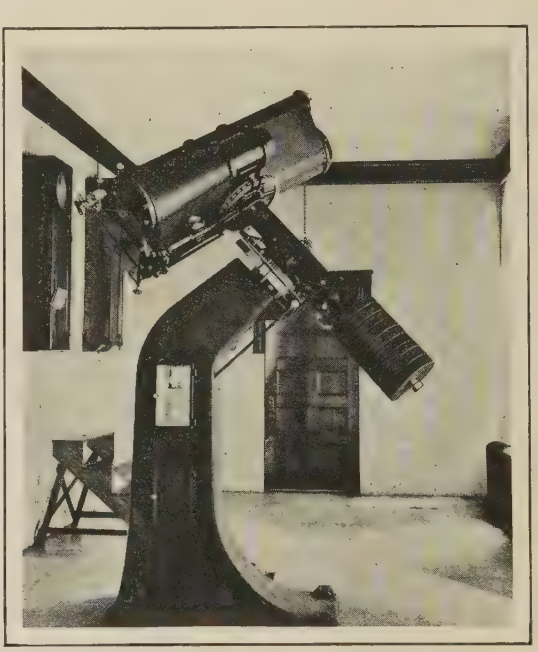
Photo by Press Illustrating Service

The Giant Mirror of the Mt. Wilson Reflecting Telescope

The original block of glass for this largest of reflectors weighed 4½ tons, and required three years in the grinding. It measures 101 inches in diameter and is over a foot thick at the edge

hand the massive cluster stars, which are mostly of high luminosity, having low peculiar velocities, and maintaining in their subsystem a high degree of stability, retain their organization longer in a disturbing field and, except for rare and accidental encounters with galactic stars, undergo as a single unit the general perturbations of the galactic system, for myriads of years they travel together as a Pleiades-like group among the galactic stars.

Another surprise comes when attention is turned to the spiral nebulæ. These, like the known globular clusters, lie outside the galactic segment with its crowds of stars, but instead of falling in toward it they appear *to be fleeing away* from it with velocities of hundreds of miles a second. Moreover, they occupy a general position with regard to the Milky Way that is in contrast with the position of the globular clusters. In the region where the spiral nebulæ approach nearest to the galaxy, globular clusters are entirely absent; and it is very significant that in the opposite region of the sky, where the globular clusters and clouds of stars most abound, the avoidance of the Milky Way by spirals reaches its maximum.



The Bruce Photographic Telescope

This wonderful instrument was made by John A. Brashear, for stellar photography. The two photographic lenses are respectively "doublets," that is, the objective is composed of four lenses, with an aperture of 10 inches and a focal length of 50 inches; the mounting also carries a Voigtländer doublet of 6¼ inches aperture and 31 inches focus. These cover plates 12 x 12 and 8 x 10 inches and produce clear, sharp photographic results

The foregoing conditions suggest as a preliminary hypothesis that the discoidal galactic system originated from the combination of spheroidal star-clusters, and has long been growing into its present enormous size at their expense. The evidence further suggests that the galactic system now moves as a whole through space, driving the spiral nebulæ before it and absorbing and disintegrating isolated stellar groups. Apparently the suggested interpretation requires that two types of sidereal organization prevail generally throughout extra-galactic space: spiral nebulæ and stars of known types assembled for the most part into globular clusters; and while the globular clusters now known are, at least potentially, members of the galactic system, the spirals are not members, rather being general inhabitants of extra-galactic space. The hypothesis demands that gravitation be the ruling power of stars and star-clusters, and that a repulsive force, radiation pressure, or an equivalent, predominates in the resultant behavior of spiral nebulæ.

How extraordinary is the picture of the universe thus presented! The great galactic system, driving through space like a flat shining raft, built up of hundreds of millions of stars—our little sun being lost among them—and drawing in from either side, and from distances of hundreds of quadrillions of miles, vast stellar organisms, of a globular shape, on which it feeds and grows, while from before it, like frightened flocks of strange winged creatures, hatched in the midst of the mysterious and boundless ether, flee the spiral nebulæ, speeding madly on—on—on.

THE LURE OF THE STARS

ASTRONOMY AND GEOGRAPHY

From a mural painting by Will H. Low, in the New York State Education Building, Albany

Minerva, goddess of wisdom, encircles with her arm a young child, while through the telescope she directs his gaze to the "clear night of stars" spread above him; at sight of which the child clasps his hands with a gesture of wonder. Near at hand a seated youth, holding the symbolic lamp of research, is bent over a large globe following the path of man over the traveled earth.

THE LURE OF THE STARS

The Story of Man's Search of the Sky

By A. A. HOPKINS, Editorial Staff of The Scientific American

THE stars are the great landmarks of space, and from the beginning of time, peoples of all lands have fallen under their spell. Emerson says: "If the stars should appear one night in a thousand years, how men would believe and adore and preserve for many generations the remembrance of the city of God which had been shown." But the starry objects are so common; they are at our service on every clear night, so we rarely think of them. In all ages, however, there have been observing and thoughtful ones who have been asking themselves questions about the universe, and trying to find an answer in the stars.

PARTIAL VIEW OF STONEHENGE

Showing the column behind which the sun rises on June 21st

ANCIENT STAR SEEKERS

Primitive man, after satisfying his material wants, had time on his hands and he employed it in speculating about those features of the universe with which he came into daily contact—notably the blaze and heat of the sun, and the cool silver light of the moon. Certain facts in the heavens started fancies and legends which, in time, crystallized into well defined myths. The first of these facts must have been the record of the passing of time, and the seasons, with their varied relations to the cultivator of the soil. Then the primitive mariner soon found the Pole Star an unwavering guide. This speculation on the heaven begot mysticism, idolatry, and astrology which Kepler called the "foolish daughter of a wise mother." This seemed to keep down the scientific aspect of the celestial objects for a time. Noah was accredited by the Chaldeans with their knowledge of the stars. Astronomy united with history and archaeology in pointing to the Euphrates Valley, and the region of Mt. Ararat as the home of those who originated the ancient constellation figures. We have been able to fix approximately the date of these early astronomers by the results of their labors as they have come down to us, and put the date at 2800 B. C. The division of the year into twelve parts indicated by the signs of the Zodiac dates from 3000 B. C. The ancients had queer ideas as to the constellations. They had nothing to deter them, so they calmly designated one part of the heavens as the "Sea" and peopled it at once with mythological marine creatures such as fishes, whales and dolphins.

ARMILLARY SPHERE

An ancient Chinese astronomical measuring instrument

In another part of the world we find the same twelve divisions used, but transformed into what is known as the twenty-eight mansions of the moon. This was China, and we derive the word "celestials" after the celestial spaces into which the empire was divided.

Reproduced from "Pictured Knowledge"

GROUPS OF CONSTELLATIONS

On the Great Bear's left, the man with the whip is Auriga, the Charioteer. He is carrying Capella, the Goat, who nursed Baby Jupiter. Perseus, with his shield, carries the head of Medusa of the Snaky Locks, and is about to rescue the beautiful Andromeda, who is chained to a rock. In the chair is Cassiopeia, mother of Andromeda, who, after Andromeda's rescue, was chained to her chair and swung round and round the pole. This constellation is the well-known "W" which you can easily find. By Cassiopeia's feet is her husband, Cepheus, King of Ethiopia. Only the head and forelegs of Pegasus, the Winged Horse, are represented in the sky. The Sea Goat with the fish's tail, is Capricornus. On the right of the picture, Bootes carries his sickle, herdsman's crook. Next is Hercules with his club. Below Hercules is Ophiuchus, the Serpent Bearer. Near the center of the sky is the Swan. Next is the Winged Lyre and below Aquila, the Eagle, carries Ganymede to Jupiter to be his cup bearer

Science made notable progress in the hands of the Babylonians, particularly when astronomy is considered. Divination, or the ability to foretell the future, was a priestly function, and this was carried to considerable lengths. The priests also noted the position of the stars and planets, which were in turn used to foretell the future. In the hands of the Chaldeans astrology, for it was not yet astronomy, made further progress. The circle was found to contain 360 degrees and twelve groups of stars were laid out in what we call the "signs of the Zodiac." For the first time

KEPLER (1571-1630)

COPERNICUS (1473-1543)

GALILEO (1564-1642)

the sky was mapped. Astrology was the mother of astronomy and is far from being dead today, as we may see from the pile of prophetic almanacs which we see on book-sellers' counters in the fall, and we still use, even those of us who do not believe in astrology, such expressions as his "lucky star,' or an "ill-starred undertaking." The five planets —Mercury, Venus, Mars, Jupiter and Saturn, were specially identified with the Babylonian gods, and as they proceeded westward their names were changed. The celestial observations under the Chaldeans became more frequent and accurate, so that in time even an eclipse could be foretold, and this knowledge descended in time to the Greeks. The ancients knew five planets, Mercury, Venus, Mars, Jupiter and Saturn, to which we add the more modern discoveries of Uranus and Neptune.

In the clear Egyptian sky the stars are wonderfully bright, and the inhabitants of the Nile Valley must have observed them in very early days. The first observatories established on the banks of the Nile seem to have belonged to the temples of the sun. The high priests of "Ra," the sun god, styled themselves "The great of sight"; that is, the chief of those who see the sun, those alone who beheld him face to face, and who from the earliest times employed themselves in preparing maps of the heavens. The priests of other deities followed their example, and in the earliest dawn of history there was not a single temple from one end of the Nile Valley to the other that did not possess its official astronomers, called "watchers of the night." Evening by evening on the high terraces above the shrine, or the narrow platforms over the temple entrances, they watched the movements of the constellations across the celestial vault above them, and carefully noted the slightest phenomena of the sky. Some parts of the chart of the heavens known to observers at Thebes between 1800 B. C. and 1209 B. C., have been found carved on ceilings of temples, and especially in royal tombs, and have thus survived to the present time.

The Greeks were great astronomers as well as physicists. The islands in the Aegean Sea absorbed a great deal of Egyptian and Phoenician culture and the knowledge of astronomy was quite well advanced for the time, but it remained for Thales of Miletus to really stabilize the new science. He could calculate eclipses with fair accuracy, and as the eclipses actually occurred, he grew in fame accordingly. Thales, Aristotle, and Hipparchus, were giants in science. This is peculiarly true of Hipparchus. The work which he performed really laid the foundations for the science of exact astronomy as distinguished from mere star gazing. He discovered the precession of the equinoxes; and he calculated and formed the first regular catalogue of stars.

The Druids are usually credited with being the earliest English astronomers, but if we are to believe the mute testimony of that prehistoric circle of boulders on Salisbury Plain, England, known as "Stone-

SPIRAL NEBULA

From photograph taken at Mount Wilson Observatory, March, 1910

henge," that primitive construction was built, perhaps, 2000 years B. C., and whoever laid it out knew enough about astronomy to arrange the stones, so that, on June 21st, the sun rises over the top of one of the stones in line with the altar. Probably the whole affair was a huge sun dial, and recent restorations will preserve it.

Men of the early days were satisfied to see the sun, the planets, and the stars without troubling much about what they were, or how their apparent motion was regulated and measured. There was one man, however, who lived from about 100 A. D. on for seventy years. He conceived the idea that the earth was the center of the uni-

verse and that the sun and planets moved in circles whose centers themselves were in motion upon other circles. This man's name was Ptolemy and his system which was generally considered as reasonable for 1400 years, is called the "Ptolemaic" plan or system. His ideas, while interesting, were very confusing, and he was deceived by his senses into believing that there was a fixed earth. He did not believe that the earth was in motion because he did not feel it. He also thought the earth was much larger than any of the other heavenly bodies.

SIR ISAAC NEWTON (1642-1727)

The Arabs were good mathematicians and did not let the spark of astronomy, slight as it was, die altogether. The "Almagest," an important work by Ptolemy, was even translated into Arabic. In 1400 Ulugh Beg, a grandson of Tamerlane, and a Tartar prince, established an observatory at Samarcand, and with instruments that were new to the world at the time, made the second star catalogue, and the earliest that is worth much. Thus, the Arabs for many centuries kept the flame of astronomy alive, and by steady improvement in accurate observations increased the value of each successive set of tables.

Discovery was occurring in all parts of the world. Printing had been invented and a great impetus had been given to the exact sciences, and, of course, astronomy received its share of attention. Things drifted on until the middle of the fifteenth century, when we come upon the great name of Copernicus (1473–1543), who was born in Polish Prussia. He saw that the rotation of day and night could be explained just as completely by the rotation of the earth itself from West to East, as that of the whole universe from East to West. He began to destroy the whole framework of error which had existed for centuries by demolishing the objections to his theories, in advance. He pointed out that only relative motion is perceived by the senses, and that the air was bound to share the motion of the earth. He also had a more just appreciation of the enormous distance of the stars and he considered that they must be of enormous size (as they are). His theories were by no means perfect in the light of our modern knowledge; but he blazed the way for his followers and the great men who were broad enough to accept his revolutionary views. His book was not published until he was in the shadow of death, for he probably knew the turmoil he was preparing both for science and the church. Confirmation soon came from another source.

It was a noble Dane named Tycho Brahe, who claimed a high place in astronomy, by reason of his accurate observations. He is perhaps the most picturesque figure in all science. His contribution to the determination of the planets, etc., in the celestial sphere, was made at his observatory on a Danish island, where he conducted his observations, *without a telescope*. By a long series of careful planetary observations, he provided the materials for the next great advance, due almost as much to him as to the great Kepler. Although Johann Kepler may be regarded as the real founder of modern astronomy, we must pause for a moment to consider another great name which is a necessary link before Kepler, for he furnished the one thing which astronomy had lacked, an artificial aid to the human eye, now called the telescope. This was the great Italian Galileo (1564–1642). Before he made his epoch-making invention he

SIR WILLIAM HERSCHEL (1738-1822)

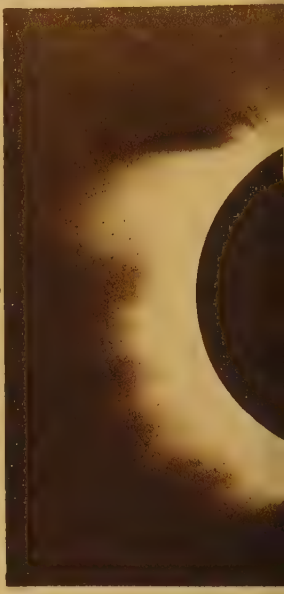
THE GREAT NEBULA OF ANDROMEDA
Our whole solar system occupies less space than the tiniest star speck in this picture

had demonstrated the laws of falling bodies by experiments which he had carried on from the "leaning tower" of Pisa. He also invented the pendulum, of so much value in our keeping of time, which is so important to astronomy. He heard that a lens had been discovered in Holland, and he at once set to work to try his hand with lenses in a leaden tube. He soon constructed a telescope which magnified "32 times"—about what we would now give to a child. Turning this crude affair to the moon, he discovered the irregularity of its surface. He also discovered the moons of Jupiter, Sun Spots, and other objects in the heavens. Galileo's story is one of the most romantic and pitiful in all science. He set up many milestones of progress, and gave Kepler (1571–1630) the tool which enabled him to confirm his discoveries. Kepler's laws are three in number and have been tersely expressed by Prof. Serviss as follows: First, that the orbits of the planets are ellipses, with the sun occupying one of the foci; second, that the radius vector (line joining the planet and the sun) sweeps over equal areas in equal times; and third, that the squares of the periods of revolution of the planets are proportional to the cubes of their distances from the sun.

NEWTON AND THE LAW OF GRAVITATION

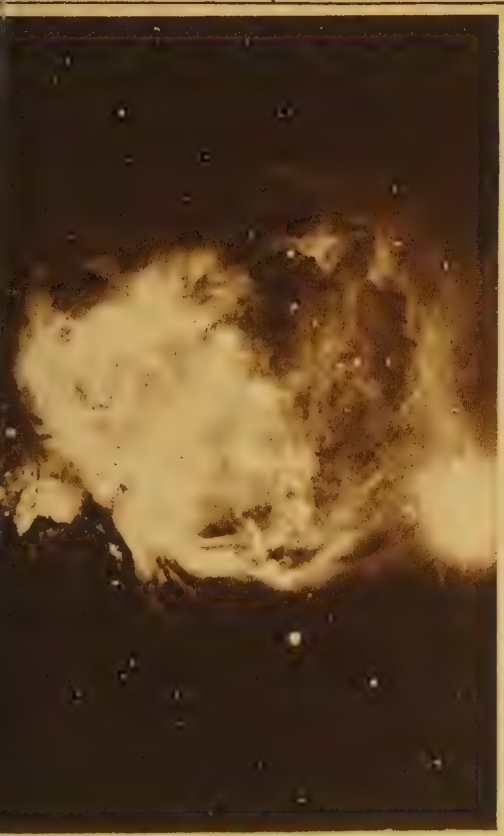
Then came a long series of more or less important discoveries, but the stage was gradually cleared for the next great figure, who may be regarded as a Christmas present to the whole civilized world, for it was on Christmas Day, 1642, that Sir Isaac Newton was born—by strange coincidence, the very day of Galileo's death. Forced by the Great Plague to retire into the country, he fell to musing, in an orchard, so legend tells us, on the fall of an apple to the ground. He meditated upon the central force that keeps the planets in their orbits. It occurred to him that a force similar to that which causes a body to fall to the earth, might, by continually deflecting the moon from a natural straight path, constrain it to revolve about the earth. This was the germ of his law of gravitation, which has been admirably expressed by Prof. Serviss as follows:

"Every particle of matter in the universe



Above is a supremely successful photograph of the moon, made at Mount Wilson. It shows the great plain called *Mare Imbrium*, meaning "Sea of Showers." It has no water now, and may never have had. Mountains of the moon are also shown. At the right is a wonderful picture of the Pinwheel of Space, a Spiral Nebula. This great "Star Factory" is shown making up star balls and throwing them off billions of miles into space

MASTERPIECES OF S



At the top, in the center, is a remarkable photograph of a solar eclipse, showing the "Corona" or circle of flames thrown out from the sun. Directly above is a picture showing what the Pleiades look like to the photographic eye. At the left is the Grand Nebula of Orion, the largest Nebula and the only one easily seen with the naked eye. These three pictures are notable examples of stellar photography at the Yerkes Observatory, Williams Bay, Wis.

AR PHOTOGRAPHY

attracts every other particle with a force which is proportional to the product of their masses and varied inversely with the square of the distance between them." This has remained unchallenged until the advent of Prof. Einstein and his "Theory of Relativity."

Sir Isaac Newton also detected the composite character of light, which he analyzed with a prism, thus laying the great foundation for a great handmaiden of astronomy and chemistry—Spectrum Analysis. He just missed discovering the achromatic (or composite) lens. For once his sagacity left him and he went on another tack and invented the *reflecting* telescope, while the honors for perfecting the *refracting* telescope went to another Englishman, Dolland, in the next century.

Some of Newton's success must be attributed to what we would call in these unregenerate days his "press agent." This was Halley, the Astronomer Royal. He induced Newton to publish his treatise on gravitation and in his long life exerted a beneficial influence on the science. He will be chiefly remembered by his work on comets. It was he that predicted the return of what we now know as "Halley's Comet," knowing, of course, that he would not be among the living when the celestial visitor arrived seventy-five years later. Thrice since his death the light of the wayfarer has shone on his grave in Kent. Except in his own country Newton's theory was received with great hostility, but after half a century Voltaire published a short but clear and popular treatise on Newton's principal discoveries in optics and astronomy, and from this date, 1738, Newton's theories may be said to have held the field.

The science of mathematics gained enormously, especially under Euler and Laplace. The latter is the author of a very famous book called "Celestial Mechanics." We would find it hard reading now, but in spite of its mistakes and the author's many assumptions without adequate proof, it will still remain as a great landmark in astronomical literature. New mathematical fields were available since the time of Newton and Laplace and did much to put astronomy on a sound modern mathematical basis.

Laplace was the author of the Nebular Hypothesis, which contended that the solar system existed originally in the form of a nebula, which by cooling, condensing and revolving was formed into the sun, and rings of matter were consolidated into the planetary bodies; applied also to all the heavenly bodies. This idea was conceived in rude form by Swedenborg, perfected by Kant, Herschel, and at last, by Laplace. The more modern developments of the theory were of great use to evolutionists, and the principal men who have used the great arguments were Herbert Spencer, G. H. Darwin, and Thomas Crowder Chamberlin.

ASTRONOMY'S RAPID PROGRESS

We now come to the era of the observatories; the telescope became more than a toy. Observatories were established at Paris, Greenwich, and elsewhere, directed by skilled astronomers and supplied with the best instruments which the makers could produce with the available materials and optical skill. The great names of Flamsteed, Halley, Bradley, lead us to the Herschels.

William Herschel, born in Hanover, was a good musician and an excellent astronomer, but proved to be a poor soldier. He deserted and emigrated to England. He manufactured and perfected reflecting telescopes and was the discoverer of Uranus—that interesting planet whose eccentric behavior led to the discovery of another new planet, Neptune. William Herschel was ably assisted by his sister, Caroline, an astronomer of no mean order herself, and on the cold winter nights she recorded his observations made in the open-air observatory until the ink froze in the inkhorn. His distinguished son, Sir John Herschel, followed in his father's footsteps.

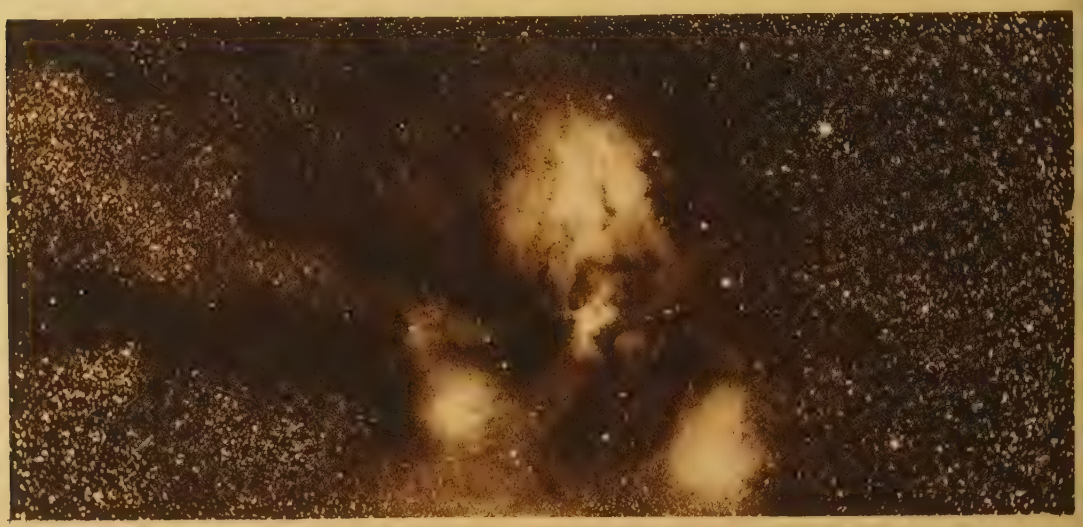
The Nineteenth Century opened auspiciously by the discovery of "Ceres" by the Italian astronomer Piazzi in 1801, thus filling up the gap between Mars and Jupiter. The age of the discoveries made by great individual astronomers was past, but the century was to see the invention of the spectroscope, of photography, the development of the telescope beyond the fondest hopes of the earlier men, and new disclosures in astronomy that astonished the whole scientific world. One of the noteworthy discoveries of the third quarter of the century was that of the relation between comets and shooting stars.

Comets are truly the ghosts of the skies, for they do not disturb the planets or their satellites when they pass by. They are self-luminous, and their brightness is probably

STAR CLOUD

A remarkable photograph showing white streaks of two meteors that flashed across during the camera exposure

increased by reflected sun-light. Many of these bodies are permanent members of our system and return regularly after a few or many years, at times determined by the astronomer; others only make the circuit once and pass into outer space. The earth is undergoing a constant meteoric bombardment, and little stones and particles of matter try to reach our earth but are usually burned up in the process. Though



GREAT NEBULA OF RHO OPHIUCHI

Lying in the Milky Way. This photograph by Prof. E. E. Barnard shows vacant lanes that seem to blot out the more distant stars. These vacant lanes are new discoveries made through the Bruce camera at the Yerkes Observatory

it has been calculated by astronomers that every day the dust of millions of meteors falls to the surface of the earth, yet the whole lot would probably not weigh a hundred tons. Meteors are the products of the breaking up of comets and consist of particles that certain comets have abandoned along their way. Occasionally a fine example like that in the American Museum of Natural History weighing a hundred tons is secured.

Expeditions were sent to the antipodes to map the southern heavens, or observe and photograph eclipses.

The best mechanical and optical talent was lavished on the wonderful instruments that swept the skies. We are indebted to an English optician named Dolland for the invention of the achromatic telescope, in which by a combination of lenses the troublesome color borders so destructive to good observation were eliminated. Dolland did away with the color distortion by making an objective of two lenses joined together by Canada balsam. One was of crown glass, the other was of flint glass. These two kinds of glass disperse light differently, and the two lenses were so put together that the one counteracted the color dispersion of the other. This invention occurred in the previous century, 1757, being the date, but it is referred to here while the refracting telescope is being considered.

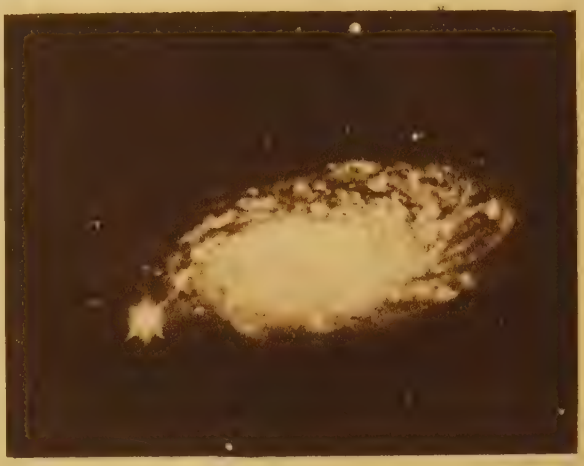
The nineteenth century owes much of its astronomical progress to the great endowed observatories, where mechanical and optical perfection is only excelled by the great ability of the directors and observers. With instruments like those cited, if we were on the moon and looked at the earth, we could see the great pyramid of Cheops in Egypt as a dot, and New York's curious contour could be plainly recognized. With the help of these huge tools, costing vast fortunes and requiring years for their fabrication, the tiniest celestial bodies, millions of miles away from us are distinctly visible. Nearly every observatory has, in addition to the master instrument, smaller telescopes and countless attachments, and other instruments, photographic and spectroscopic.

The perfection of the telescope now went hand in hand with the splendidly equipped astronomers, and the last touch was given by photography, and later, by spectrum analysis, which opened an entire new world. Astronomy became now specialized, so we had comet-seekers like Encke, Bielia and Schiaparelli. Star catalogues multiplied, photographic star charting became of great importance, observatories pooled their efforts and divided the sky among them, and the outcome of their combined operations aimed at the production of a catalogue of at least 2,000,000 strictly determined stars together with a colossal map in 22,000 sheets. Stars have to be classified by their apparent light power, and this is measured by the "photometer." The splendid achromatic lenses of the famous Clarks of Cambridgeport allowed great discoveries of double stars.

From photograph by Prof. E. E. Barnard

BROOKS COMET OF 1911

The Bruce telescopic camera was timed to keep pace with the comet, hence the stars appear as streaks. Observe that the stars appear undiminished in brightness through the comet's tail, showing the diaphanous nature of the tail



SPIRAL NEBULA

Photograph made at Mount Wilson Observatory, March, 1910, showing clearly the great whirl that forms stars

The wonderful researches in astronomical photography carried on by Draper, Young, Campbell, Huggins, and others, have added vastly to our sum total of knowledge of the celestial world. The adoption in 1876 of the "dry" gelatine plate with its greater speed and general convenience was of great importance. It made long exposures possible so autographic impressions of such faint objects as nebula, comets, etc. Photographs of stellar spectra were multiplied and many "new" and variable stars were discovered, not by the telescope *but from the photographic negative.*

THE "NEW" ASTRONOMY

The so called "new astronomy" concerns itself with the individual peculiarities of suns and planets with their chemistry, their physical habits, and their modes of luminosity, rather than with the positions of the heavenly bodies in space, and the changes of this position with time, with which the earlier school of astronomy concerned itself. When Newton analyzed the sun's light by passing it through a glass prism, he was taking an early step in the vast field of spectrum analysis. Spectrum analysis is distinctly a development of the nineteenth century and it has profoundly altered our purposes of celestial inquiries. By analyzing the rays of light as they are dispersed on a screen by the prism of a spectroscope, the material elements—gaseous, and metallic—that go to make up the sun and stars can be determined. This laid the foundation for the far-reaching science of "celestial chemistry." These discoveries aided by the photographic camera and the "gratings" invented by Prof. H. A. Rowland, an American, has resulted in the detection of forty terrestrial elements in the sun. Stellar spectroscopy is now a recognized branch of astronomy. The investigation of sun spots, solar prominences, etc., all owe an enormous debt to Newton.

With the second decade of the present century one or two discoveries loom up very large in the astronomical horizon. Dr. Harlow Shapley's researches on the scale of the universe have been received with profound respect, and also Prof. Michelson's new method of measuring the diameter of a star, which supersedes human vision. This instrument, called the "interferometer," was invented by Prof. Michelson and is attached to the 100-inch reflector of the Mount Wilson Observatory. With this device "Betelgeuse" in the Constellation of Orion was found to be 300,000 miles in diameter against our own 8,000 puny miles. Prof. Garrett P. Serviss, in this issue of The Mentor, gives us the latest word in astronomy on these two subjects. With their amazing

"Seeing the City" in New York is expensive, but you can see the Sun for five cents

LARGER NETWORK NEBULA
Photograph made at Mount Wilson Observatory, July, 1910

discoveries the story of Astronomy is told to the present date. In the past ten years the use of photography in astronomical research has brought out startling new facts. Undoubtedly the future holds even greater wonders in store for us.

THE PLEIADES

The Seven Sisters of the Sky. From the painting by Elihu Vedder, in the Metropolitan Museum of Art, New York

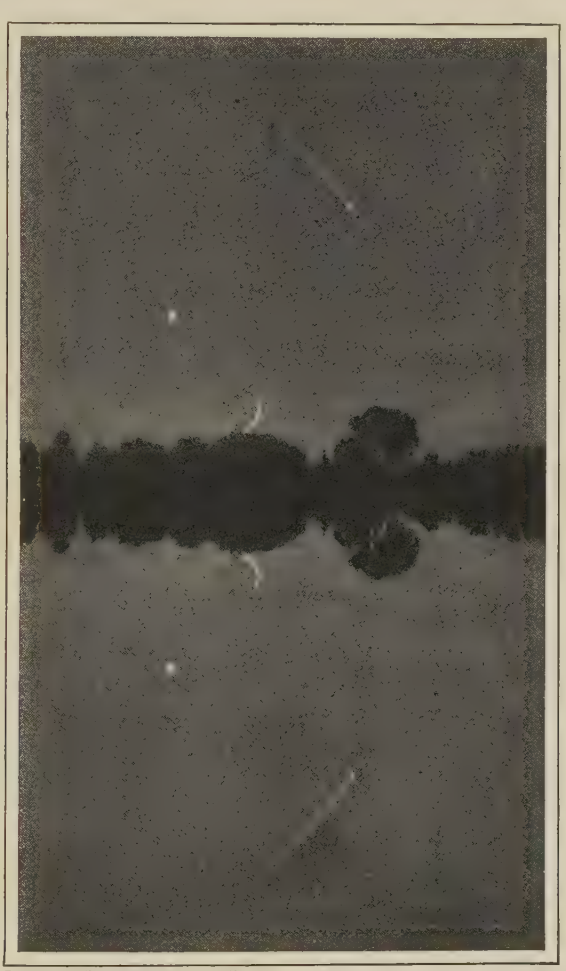
A COMET THAT COMES BACK

OF ALL the comets that blaze in the sky, there is only one that pays the earth regular visits. This is Halley's Comet, which swings around its orbit with the unfailing system of a railroad train. Previous to 1910 it was visible in 1835, and before that in 1758 and 1682. It has the most interesting history of any of these vagrants from outer space. In contrast to the dependable movement of the planets, comets, with the exception of Halley's, follow an erratic schedule. Most of them are so faint and far away that they can only be seen through powerful telescopes, and few ever have been seen more than once.

Edmund Halley, an English astronomer, who lived two centuries ago, was the first to map the path of the comet, and determine that it had been coming in view regularly every 75 or 76 years, as far back as astronomical records were kept. During his studies to discover whether any of the known comets appeared to have the same orbit, he found that the track of the notable comets of 1531, 1607, and 1682 were similar. Finally he convinced himself that they were one and the same comet.

Halley staked his reputation on the theory that this comet would again appear three quarters of a century after 1682—the year when he made his observations. "If it should return," he wrote rather plaintively, "impartial posterity will not refuse to acknowledge that this was first discovered by an Englishman."

Halley died in 1742 and was buried not far from Greenwich. Astronomers did not forget his prophecy. As the date drew near when it should be fulfilled, men of learning searched the sky. A French scientist computed that the influence of certain planets would retard the comet for twenty months. A farmer student living near Dresden was the first to see it, on the night of Christmas, 1758.



Courtesy "Popular Astronomy"

Halley's Comet (1910), Venus, and the Crescent Moon

A remarkable photograph showing their reflection in the water

When there was no longer any doubt as to the truth of Halley's prediction, astronomers were able to formulate a table showing that for fourteen centuries it had been recorded as far north as Iceland, as far to the east as China. They identified Halley's Comet with the one that had attracted the attention of all Europe in 1066, the year of the Norman Conquest.

Comets have often been objects of superstition and alarm. In 451, a "fearful star with a tail" was thought to have influenced the defeat of Attila the Hun. This comet was doubtless the "sword-shaped sign" that hung over Jerusalem before a disastrous war. In Europe, medals were sometimes issued previous to its appearance and worn as talismans against war, pestilence, and famine.

HE MEASURES THE MILKY WAY

SWARMS of giant suns in stupendous globular clusters, swarms of pigmy ants in rotting mountain-side logs—what have they in common?

The speed and temperature of far-flung stars, the speed and temperature of earth-bound insects—what relation is there between them?

Whatever the answers to these questions, Dr. Harlow Shapley, who is measuring the extent of the Milky Way, and revealing to man what an insignificant place his earth and its animal life holds in the material universe, also delves into the problems of life on this same trivial earth, and into the problem of the mechanism of living. In a recently published biological paper he announces the discovery of hundreds of "missing links" in the evolution of ants, describing worker ants that have minute vestiges of wings on their backs, an indication that millions of years ago all ants were winged and are descended from wasp-like ancestors. More remarkable are his observations that the speed of ants depends so closely on temperature that for some species the time of running through a "speed trap," as shown by a stop-watch, gives the temperature of the surrounding air within one degree! The speed at 100° is twelve times as great as at 50°! Other observations on the ants of the California mountains deal with the astonishing and barbaric custom of slave raids and of enforced slavery in the ant world.

Dr. Harlow Shapley

Dr. Shapley, whose astronomical work is given credit for marking a new epoch in our conception of the immensity of the stellar universe, is a young man as the age of scientific investigators is reckoned. He was born at Nashville, Mo., in 1885.

After attending various preparatory schools, he commenced, while a student at the University of Missouri, which he entered in 1907, the studies that later resulted in the new conclusions as to the size of the perceptible universe. He was from the first interested in the study of the "Cepheid variables," those brilliant stars that are thought to be tremendous globes of pulsating gases, a hundred times brighter than the sun. The three years following 1911 were spent at Princeton, where he studied and worked with Professor H. N. Russell, receiving the degree of Doctor of Philosophy. In 1914 he joined the staff of the famous Mt. Wilson Observatory in California, going on a leave of absence in March of this year to the Astronomical Observatory of Harvard University.

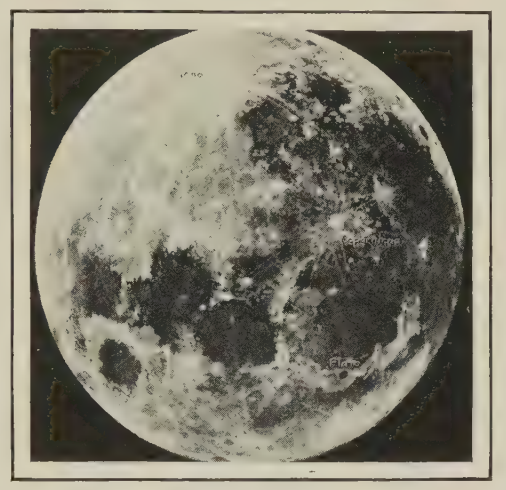
It was at Princeton that Dr. Shapley and Professor Russell developed methods of determining the distances of variable stars.

At Mount Wilson Dr. Shapley perfected his method of measuring star distances photometrically. He then applied the method to the problem of the distances and structure of the great star-clusters, with the result that the stellar universe, as known to scientists, is at least a *thousand times larger* than it was before the distances to the clusters were measured.

The earth is but an infinitesimal unit in this universe and the sun holds no such important position as has heretofore been accorded it. Dr. Shapley found that a local cloud or cluster of stars surrounding the sun had contrived to deceive astronomers as to the sun's position. This local cloud, when measured, was found to be at least 60,000 light-years (a light-year is six trillion miles) from the center of the Milky Way. The cloud of surrounding local stars helped to make the sun appear to man to be at the center of things universal, a belief that Dr. Shapley's studies have now dissipated.

DOES THE MOON INFLUENCE OUR WEATHER?

YEARS ago, when an almanac could be found in every farmhouse, it was customary to associate weather changes with changes in the phase of the moon. Those almanacs, usually printed long before the beginning of the year to which they referred, contained general weather forecasts. As the forecasts were not specific and were not limited to a designated region it is reasonable to suppose that they were often verified, for one can find almost any kind of weather in some part of the United States every day of the year. Changes in moon phase appeared to be the principle upon which these long-range weather forecasts were based, in so far as they had a base.



The Full Moon

When human intelligence was at a low ebb, great numbers of people were guided in important matters by the changing phases of the moon. Some farmers planted and harvested "according to the moon."

Fortune tellers, clairvoyants, and others of that ilk who prey upon the unsophisticated still keep alive these so-called mysteries. Occasionally one hears of some backwoods farmer who still sows and reaps "according to the moon."

As a result of modern scientific research people have learned a great deal about the moon and other heavenly bodies during the past few years. Here are some of the facts which have been revealed by the researches of astronomers at Lick Observatory and other institutions:

The moon is a comparatively small and dead astronomical body which revolves around the earth in about twenty-nine days. It is our nearest neighbor in space. It was once part of the earth. Some time during the process of cooling the earth cast off this smaller mass, and it continues to revolve around it as a satellite. Some planets have several satellites. The earth has but one.

The moon continued to cool after becoming detached from the earth. If it ever had any water it has long since been lost, for to-day the moon is dry and dead. There can be no life on the moon at the present time. It no longer has light or heat of its own. The side exposed toward the sun must get extremely hot as a result of solar radiation, and must get proportionately cold when it is again turned away from the sun. Moonshine is simply reflected sunshine. The small amount of reflected heat received by the earth from the moon is too slight to be appreciable.

In addition to the illuminating effect of moonlight, the moon exerts certain influences upon the earth. Its gravitational pull upon the earth results in the tides of the ocean. Moreover, the same pull causes earth tides. These are not appreciable to our senses, on account of the rigidity of the earth, but they can be detected with the aid of delicate scientific instruments. The same gravitational attraction causes tides of the atmosphere. These, too, are inappreciable to our senses, but their presence is shown graphically by the recording barometer almost every day by two distinct waves made by the pen in contact with the revolving drum. This instrument records the pressure or weight of the atmosphere, an important consideration in scientific weather forecasting.

Occasionally one hears it said that the moon drives away the clouds. That is a delusion. Clouds of the cumulus type naturally dissipate and vanish in the evening when the earth cools and air currents ascend. Moreover, clearing at night is rendered conspicuous when the moon is up. Weather proverbs based upon the appearance of the moon or its changing phases are unworthy of our respect, for the moon does not influence our weather to any appreciable extent.
—*A. H. Palmer, Meteorologist, U. S. Weather Bureau.*

MODERN ART AND "ISMS"

SOME years have elapsed since the "Nude Descending Staircase" was sprung upon a startled public at an exhibition of Cubist and Futurist paintings. One critic dubbed it "Explosion in a Shingle Mill." A storm of anger and ridicule greeted it and other pictures of its kind. What the painters of these apparently formless figures, splotches of color, whorls, and spirals were driving at was and is incomprehensible to the average person. Yet they have not been laughed off the stage, have grown in numbers, and are exerting great influence over young painters throughout the world.

Like all movements, these modern art movements have suffered at the hands of extremists, notoriety seekers, and incompetents, but in the main are sincere efforts to produce truer and finer painting than was done by the majority of artists in the nineteenth and early part of the twentieth centuries. They cannot be dismissed as the work of men that were unable to measure up to the standards of academic art, for some of their exponents were originally academic artists of rank. Matisse, for instance, whose painting irritates academic critics above all others, was once held to be one of the finest draftsmen in France by these same critics.

Post-Impressionist

Paul Cézanne, leader of the Post-Impressionists, as he painted himself in the manner of his school

It doesn't do to laugh at them or label them the work of crazy men and proceed to forget them. Paris did these things when the Impressionists first exhibited and the work of Impressionists now hangs in the French national galleries. Edouard Manet, the Impressionist leader, couldn't sell his picture, "Dinner in the Studio," then. When it was exhibited in New York, not so long ago, the price was $7,000 and later it was sold for $60,000 to the Munich Art Museum. Another Impressionist painting, by Renoir, which brought $22 at the time it was painted, has since been sold for $14,000. So intense in their work and eccentric in their habits were some of the Post-Impressionists that they were all thought to be crazy. One of them, Van Gogh, died in an asylum after cutting off his ear and sending it to his friend, Gauguin, as a sign of contrition following a quarrel. His painting was not the result of his malady, however; insanity followed a sunstroke suffered while painting in the hot sun of Provence. Van Gogh and Gauguin paintings to-day command high prices.

That Mentor readers may be able to judge intelligently the work of the new schools, the Editor asked Professor John C. Van Dyke, one of the best known American writers on art, to explain the new schools. It follows:

"Attempts to follow the recent movements in painting lead nowhere, because the movers themselves do not quite know where they are moving. There is Babel and discord, with no well-defined objective. In a general way it may be said that almost all the movements are toward a newer and greater realism through exaggeration or suggestion. They are developments of older movements. In Greek sculpture the chin and jaw are round, decorative, characterless; in Botticelli the chin tends to a triangle from the cheekbones down, and the result is to give a pathetic or emotional character; in Courbet, Millet, increasingly so in Cézanne, Gauguin, and Van Gogh, the jaw is heavy, tending to squareness, and reveals strong masculine character; in Picasso it becomes square, cubistic, so positively exaggerated that it shows not character but caricature.

"Recent painting seems bent upon attaining strength at the expense of every other quality. Strength in drawing is gained, not by the smooth or round line but by the broken and the angle line. Academic art having used the graceful and the flowing to produce roundness seems one reason for Cubism using

the harsh and the angular to produce squareness. The points of angles are more obtrusive than the rounded contours. An elbow forces itself upon the attention more positively than a shoulder. Therefore the elbow is put in with angle lines, and (to emphasize movement) repeated several times from different points of vision. The whole figure is perhaps repeated in various aspects on the one canvas. By duplication of a figure, an elbow, a hand, many times it is thought to give the impression of a figure or hand in movement. "A running horse has twenty legs instead of four." That is Cubism and in measure explains the much discussed "Nude Descending Staircase," or any of the cubist work of Picasso, Picabia, and others of this new school.

The Famous "Nude"

An example of Cubist painting by Marcel Duchamp, "Nude Descending Staircase," that stirred the art world when first exhibited

"Futurism has its affinities with Cubism. It derives from Cézanne and exaggerates features known to academic art. For example, it has long been known that the horizontal line produces a feeling of repose, the perpendicular line a feeling of dignity, the broken line a feeling of action. Futurism tries to suggest movement along a road by zigzags, by portions of trees, fences, horses, people—all the things one would see in motoring along a road; it exaggerates height in a figure by repeating the long vertical lines of the arms, legs, and neck; it portrays repose by exaggerated horizontal lines of figures, lowlands, waters, clouds. Besides this, Futurism argues that the observer should be, not out of the scene, but *in* it, a participator, with action going on all around him instead of just in front of him. That leads to suggestions of things seen at the sides or back and naturally confuses the things really seen in the front. In this respect Futurism attempts a larger realism which it cannot completely realize. The movement is said to have originated with Boccioni, Cara, and Russolo, but its followers to-day may be counted by the score.

"Synchronism exaggerates in color as Cubism and Futurism exaggerate in line and form. Delacroix knew about complementary colors and also knew and applied in painting the theory that certain colors symbolize certain feelings or emotions. The grays were productive of sadness, the reds of gladness, the yellows of warmth, the blues of coldness. Synchronism has developed this knowledge and has also put forth, with additions, the Impressionist theories of color—vibration, juxtaposition, and relation. It uses color, not in points, but in related blocks. The bright-colored blocks stand for light; the dark-colored blocks for shadow. Color is fundamental and dominant with Synchronism—as much so as in color-music. It seeks by the suggestiveness of related colors to symbolize states of emotion or feeling."—*John C. Van Dyke.*

The Futurist Method

"Bal Tabarin" by Severini, in which the painter seeks to give the observer the composite effect of a ballroom upon a man in the picture, not in front of it

THE BANK OF ENGLAND WAKES UP

THE venerable Bank of England is to be remodeled, brought up to date. This causes as great a stir in London as if the lions of Trafalgar Square were to be given a coat of gilt paint, or the white paper money issued by the National Bank tinted green.

The "Old Lady of Threadneedle Street" is to have a new dress. She is the richest old lady in the world, and can easily afford it. Her vaults contain millions of dollars in gold and silver bullion, and every day she prints and issues fifty thousand promissory notes, with a value of $25 to $5,000 each. The porters at her doors wear crimson and gold lace; her messengers are arrayed in salmon-colored, long-tailed coats, black trousers and high hats. They brighten the dim old streets of the city as they go about on their errands.

© U. & U.

The Bank of England
Frequently called "The Old Lady of Threadneedle Street"

The bank, a private stock company, was founded in 1694. The buildings it occupies at present were designed by a famous architect, Sir John Soane. The low irregular pile covers three acres of land in the busiest quarter of London. It is the most celebrated and powerful banking institution in the world, and one of the oldest. Its history is the financial history of the British Empire, and its musty records are animated with tales of romance, stress, and adventure.

William III needed money to fight Louis XIV of France. Before he came to the throne, the pockets of the people had been the treasury of English kings. Instead of robbing his subjects or borrowing from foreign nations, King William proposed that the Bank of England should raise a loan of $6,000,000. The Government has never been out of the bank's debt from that day to this. The institution is managed by a directorate of London financiers. The constitution under which it was organized excluded Scotchmen, Quakers, and Jews from the board. A governor and deputy governor are appointed for a term of two years.

The bank receives, keeps, and pays out all public revenues. It manages the public debt; it advances money to the Government and to private banks. Any person can send gold to the vaults and have it kept there without charge.

All the printing for the bank is done within the walls—walls that are windowless. The antiquated halls and banking rooms are lighted by nine inner courts. The corporation has the exclusive right to print and issue British bank notes. Each note is issued only once. It is canceled on its return to the bank. Some notes circulate only a single day. Full particulars are recorded of the person or firm that sends in each note. The paper money is then numbered, arranged numerically, filed for reference in case of fraud or dispute, and kept five years before it is burned. The "Strong Box of the Empire" has many times been cheated by swindlers. Bank note forgeries became so alarming at one period, a hundred years ago, that issuers of forged notes used to be hanged regularly on Monday mornings.

In 1780, the bank was threatened by a mob of marauders. The "Gordon Riots" are described by Dickens in "Barnaby Rudge." The attack failed, but ever since that day a detachment from the Tower of London has stood guard at the bank. It is the custom, and has been for 140 years, to serve a hearty dinner of roast meats and other favorite English dishes to the officer of the day and two friends. Needless to say, the "Beef-eaters" of the Tower will oppose the passing of this ancient custom, when new buildings supplant the old.—*Richard Dean.*

HE WAS WISE FOR OTHERS

ONE hundred years ago, Charles Caleb Colton, parson, wine merchant, extortionist, and author, published one of the most unique books in English—"Lacon." Notorious as was its author, his name is now known only in connection with the book which is as pungent, biting, and applicable to conditions to-day as it was when it appeared on the London bookstands.

"Lacon" is, as he described it, "Many Things in Few Words for Those Who Think," a collection of aphorisms and penetrating observations on human character.

Colton was curate of Tiverton, a graduate of Cambridge, and a scholar of note. He was much talked about because of his sporting habits. He spent more time hunting and fishing than on his religious duties. Then, too, he caused a stir with a pamphlet on the Stampford ghost, a neighborhood hoax which completely fooled him. One Sunday, after having come from a deathbed, he confessed his shortcomings in a moving sermon and promised to change his ways, but, several Sundays later, gabbled through a short service and hurried off to his favorite hunting ground. His gig, dog, and gun had been waiting outside. At Kew, where he was sent as vicar, he kept his cigars under the pulpit, saying the temperature was just right there, hunted and fished with as much gusto as ever, and shocked the King of Hanover by preaching in gray trousers. "The value of a religious truth does not depend upon the color of a man's trousers," was Colton's reply when he was told that the king had expressed his disapproval.

Kew and its country ways bored Colton, so he moved, guns, horses, dogs, and books, to London. On Sundays he drove out to his church to preach, but on week days he was an author, wine merchant, shoe merchant, and other sorts of business man. He lived in a cellar under a Methodist chapel. Here he wrote "Lacon" on the backs of envelopes, old letters, and scraps of paper at such times as he was not busy with his various enterprises. A friend found him scribbling away in an old green dressing gown, a broken wine glass for an inkwell, a deal table for a desk. An excellent bottle of wine, from a sawdust bin under the bed, reconciled the visitor, however.

In 1824, Colton disappeared. He was hopelessly in debt. He reappeared at Gottenburg, Sweden, and then at Newport, Rhode Island, where he went under an assumed name. He remained in America two years, part of the time in New York, where he wrote for newspapers, and part in Charleston, S.C., where he was lauded by the "Southern Literary Journal."

Back in Europe, Colton made a futile effort to regain his vicarage and then settled in Paris. He became a correspondent, horse dealer, and picture broker. He wrote a treatise showing that gambling ends in ruin, then staked his last money on the wheel. He won, doubled, doubled again, and continued until he broke the bank. He ran his winnings up to $125,000, kept them in an iron box in the floor of his Palais Royal apartment, and carried a pistol. He was as shabby as ever but always appeared covered with expensive jewelry. In the end, what with the picture business and the gaming table, he lost all.

An old malady was approaching a crisis that made an operation inevitable. Colton moved to Fontainebleau, made his will, discussed his chances for recovery with a friend, and, the same night, shot himself through the head, April 28, 1832.

Colton Laconics

HERE are some of the aphorisms of Caleb Colton, the man that was wise for others. Some of them, written in connection with current events of his day, are astonishingly applicable to current events of to-day—a century later:

Of the professions, it may be said, that soldiers are becoming too popular, parsons too lazy, physicians too mercenary, and lawyers too powerful.

There are no two things so much talked of, and so seldom seen, as virtue and funds.

Questionnaires are formidable, even to the best prepared, for the greatest fool may ask more than the wisest man can answer.

The mob is a monster—strong to execute, but blind to perceive.

Great men, like great cities, have many crooked arts and dark alleys in their hearts, whereby he that knows them may save himself much time and trouble.

There are some men whose enemies are to be pitied much, and their friends more.

Law and equity are two things which God hath joined but which man hath put asunder.

FIRST AMERICAN LAW SCHOOL

IF TO-DAY you should visit that rare New England village, Litchfield, Connecticut, you would find near the corner of East and South streets an austerely simple little frame building, with a tablet upon its western face. Within, a gift-shop displays its wares; but the tablet says: *Judge Reeve's Law School Building—1784.* These words are curiously uninforming; and you might turn away without thought of this diminutive, Quakerish building once housing the *first law school in the United States.*

The Humble Cradle of American Law

Only a few months after the peace of Paris had ended the Revolutionary War, and four years before the Constitution was adopted, students with portfolios and inkhorns were passing along the shady Litchfield ways toward this modest lecture hall. It then stood on South Street, close by the dwelling of the learned lecturer, Tapping Reeve. Reeve, at that time forty years of age, was a Princeton graduate who, having been admitted to the bar in Hartford, had begun practice in Litchfield—in those days a town of decided importance in Connecticut affairs.

Reeve had married the only sister of Aaron Burr, and, before the outbreak of the Revolution, Burr lived and studied in Reeve's Litchfield home.

Like many another attorney, Reeve received into his office young aspirants to legal fame. His tutelage must have been valued, for his students finally became so numerous that, to accommodate them, he had to put up the little building that, in its restored form, is pictured here. In this modest structure, Reeve's law school, in 1784, entered upon the half-century of its remarkable career. In 1798, James Gould, who had just been graduated from the school, became associated with Reeve in the joint work of instruction, and Gould's office building, long since destroyed, was used for part of the classes. Age compelled Reeve's retirement in 1820, but Gould, with the aid of various instructors, continued the school until 1833.

At times more than sixty students were in attendance, and every State of the Union was represented. The course was for fourteen months, with vacations of two weeks each; and the fee was $160. Every Saturday was examination day, and mootcourts were frequently held. There were no text-books then. Law of all kinds in this country was in a chaotic and undeveloped condition. When Reeve began his work, not a volume of reports of decisions in any United States court existed. The Constitution had yet to be interpreted, and complicated adjustments between Federal and State governments had yet to be made. A full tribute has never been paid to the services of the Litchfield Law School.

Among the graduates of this school—which, strange to say, was never incorporated—were 50 representatives in Congress, 15 United States senators, 10 governors of States, 7 foreign ministers, 5 secretaries in the Cabinet, 44 judges of Federal and State courts, and 2 justices of the United States Supreme Court. In the list of distinguished alumni, probably the best known was John C. Calhoun, class of 1805, who planted elms that are still standing on West Street. The catalogue also shows the names of Levi Woodbury, John Y. Mason, and John M. Clayton. Horace Mann took the course here; so did John Pierpont, the poet, and George Catlin, the ethnologist and painter.

The school's successor, the School of Law of Yale University, was not opened until 1843, ten years after Tapping Reeve's pioneer institution had closed its doors forever.

George S. Bryan.

Effective Work Demands Modern Equipment

Success is for those who take advantage of every opportunity. Notice how frequently the man of affairs uses

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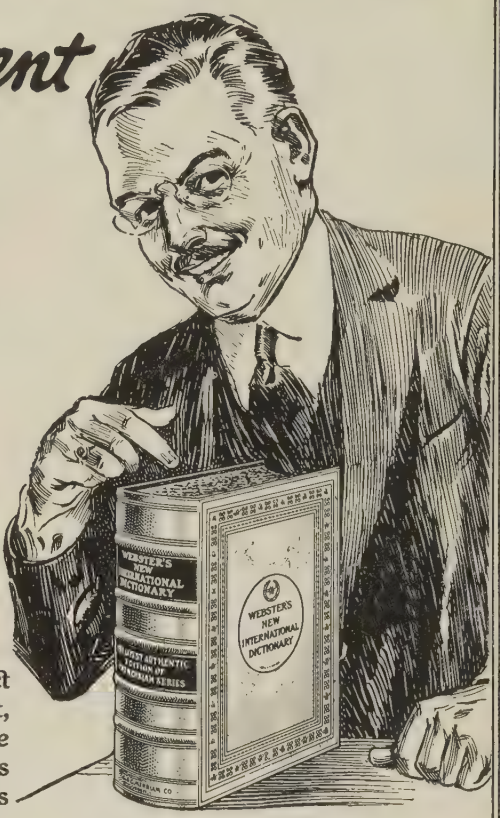

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? ? ? WHO: WHAT: WHEN: WHY ? ? ?

***On this page we print such questions and answers selected from our daily mail as seem to have a general interest.*

Question. Where and when was Joan of Arc put to death?

Answer. She was burnt at the stake at Rouen, France, May 31, 1431, after a cruel, unjust, torturing trial. You will find the full story of Joan of Arc, written by Ida M. Tarbell, in Mentor No. 98.

Question. What is Magna Charta and who signed it?

Answer. It is the great charter of liberties of England, granted and signed by King John in a conference between him and his barons at Runnymede, June 15, 1215. It has many protective articles, securing the people against abuses of the king's power. Its most important article provided that no freeman could be taken, imprisoned, or proceeded against except by the judgment of his peers or in accordance with the law of the land.

Question. What are Ruskin's "Seven Lamps of Architecture"?

Answer. Ruskin's great work, published in 1849, was written in order to arouse a new and finer conception of the meaning and beauty of Architecture. The author considers Architecture from seven different points of view, each one of which is named a lamp. The seven lamps are as follows: The Lamp of Sacrifice, The Lamp of Truth, The Lamp of Power, The Lamp of Beauty, The Lamp of Life, The Lamp of Memory, The Lamp of Obedience.

Question. What is "The Lion of Lucerne"?

Answer. The figure of a lion hewn out of the living rock on the side of a cliff overlooking a little lake in the public park of Lucerne, Switzerland. "The Lion of Lucerne" was designed by the great Danish sculptor, Thorwaldsen, and it is a monument to the memory of the brave Swiss Guards who fell in defense of Marie Antoinette in the Tuileries at Paris, on the terrible 10th of August, 1792, when the crazed mob broke through the gates and ran riot over the palace. Seven hundred of the Swiss Guards were brutally massacred, and King Louis XVI, Marie Antoinette, and the royal family were taken prisoners. So "The Lion of Lucerne" was not only a memorial to the Swiss Guards, but also to the day upon which the Bourbon kings in France ceased to reign.

Question. What is the meaning and origin of "*E Pluribus Unum*" on our coins?

Answer. *E Pluribus Unum* means "One from many," and it was suggested as a national motto by John Adams in 1782. While Adams was Minister to England, Sir John Prestwick, an eminent English antiquary, suggested to him the Latin phrase as a good motto to indicate the union of the colonies. John Adams passed the idea on to the Secretary of Congress, Charles Thompson, who commended it to Congress as a design for a government seal—the motto to be borne on a ribbon held in the beak of an eagle.

Question. What is the Sorbonne?

Answer. In the 13th century, Robert de Sorbon, chaplain of St. Louis (Louis IX of France), founded an educational institution in Paris for the benefit of poor young men of France, ambitious to study science and theology. Many of the most gifted French scholars graduated from The Sorbonne, among them the great Cardinal Richelieu. Lectures are still given gratuitously at this famous university. Madame Curie and other celebrated scholars are on the staff of professors.

Question. Was Longfellow's Evangeline a real character?

Answer. The story of Evangeline is based on fact, but there was no character of this name mentioned in Acadian history. Longfellow first intended to name his heroine "Gabrielle" or "Celestine," but chose "Evangeline" for the sake of the meter. There was a true story, told to the poet by Nathaniel Hawthorne, of "a young couple in Acadia," who on their wedding day were parted by British soldiers, never to see each other again, until, after years of searching, the wife found her husband on his deathbed. Longfellow made use of this story in his poem.

Question. What is meant by the term, "Barbizon Painters"?

Answer. Barbizon is a small village near the Forest of Fontainebleau. It became noted as one of the favorite haunts of French painters, many of whom became very famous. The Barbizon School or Fontainebleau School, as it is also called, has among its original members such painters as Rousseau, Millet, Corot, Dupré, Daubigny, Diaz, Troyon, and others equally celebrated in later years. The Barbizon School took form about 1849, when Rousseau went down from Paris to the little village. Several years after, Barbizon and the Forest of Fontainebleau were the scenes of the work and humble life of a great many master painters, the best known to us in America, probably, being Millet, the painter of "The Angelus," "The Sower," and "The Gleaners."

Question. Where and when did Aaron Burr die, and where is he buried?

Answer. Aaron Burr died at Port Richmond, Staten Island, on September 14, 1836, and he is buried in the old Princeton cemetery close by the graves of his father, Aaron Burr, Sr., and his grandfather, Jonathan Edwards, both of whom had been Presidents of Princeton College. It has been said that the marble monument to Aaron Burr in this cemetery does not mark his grave, but is simply a memorial. We have, however, the authority of James Parton, and other historians, that the remains of Aaron Burr lie "according to his own request in the cemetery at Princeton, near those of his honored father and grandfather."

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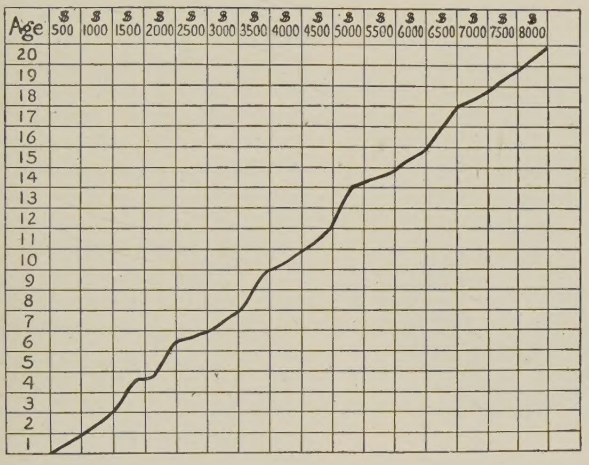

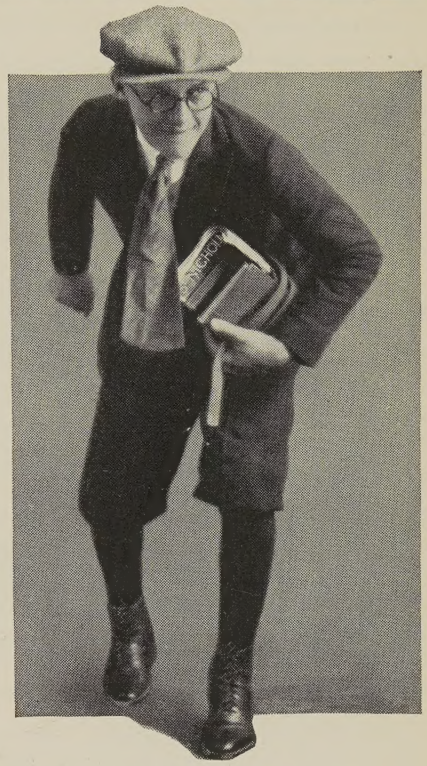

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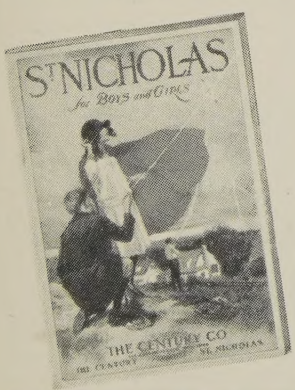

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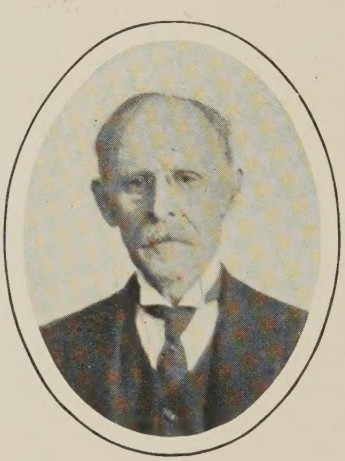
THE OPEN LETTER

MR. SERVISS'S article is full of significance for us little humans who think we know what "greatness" is. In the light of what he tells us, our solar system, which we have always considered so vast, is apparently a mere, insignificant "side show" in the universe. The full meaning of his facts and figures cannot be grasped at once—some of them cannot be truly grasped at all by the average mind. What concerns us most directly, of course, is the effect of all these amazing discoveries on the accepted theories of the origin and evolution of our sun and the family of planets to which we belong! I put that question to Mr. Serviss, and got the following answer:



Garrett P. Serviss

"It is true that these discoveries minimize by contrast this poor little old earth of ours and the farthing-candle star that lights it, called the 'Sun.' But the discoveries also throw new light upon the evolution of our sun and its planets, whose probable age they magnify as much as they diminish the relative size. Thus, as pointed out by Dr. Shapley:

"Some of the great globular star-clusters are more than 200,000 light-years away. It is plain from this that the light of the most distant clusters must be 180,000 years longer on its journey to us than is the light from the nearer clusters. Therefore, we do not see them as they are simultaneously, but as they are at an interval of 180,000 years apart. Now, if we assume, as there is reason to do, that these clusters are of about the same actual age, then the nearest one, *as we see it*, must have been in existence 180,000 years longer than the most distant one, and must consequently be advanced by that amount of time in its evolution. Any considerable changes that have taken place during that interval should be evident to the spectroscope, which analyzes the light of the stars.

"Here comes the remarkable thing: When the light of two star-clusters separated by that long interval of time is analyzed *no evidence of evolutional change appears.* This proves, not that *no* evolution is occurring, for there is plenty of evidence that all the stars are subject to regular evolutionary processes, but that the evolution is *enormously slower* than has hitherto been believed. According to the celebrated Helmholtz hypothesis, the sun's energy of radiation is maintained by the contraction of its volume and many calculations based on this hypothesis have shown that the sun cannot have been in existence, as a sun, for more than twenty or thirty million years, and that in five or ten million years more it will be extinguished. The geologists have loudly asserted that this was far too little time for the development of the progressive life forms that have dwelt on the earth, but the astronomers have replied, in effect: 'We can't help that; look at our figures.'

"But now, in view of the evidence concerning the very slow development of stars in the globular clusters, the astronomers are in a position to revise their calculations, and look for some other explanation of the origin of the light and heat of the sun and other stars. Among such possible explanations the phenomenon of radio-activity has been suggested, but it is insufficient. Another and better explanation involves the slow annihilation of matter, deep within the excessively heated stars, and its transformation into radiant energy. Anyhow, in the light of the new discoveries, we appear to be in the midst of a revolution in our theories of the origin and development of the universe."

W. D. Moffat

EDITOR

SPECIAL EDITORIAL NOTE. In our August "Ocean" number, a statement is made in the legend of the frontispiece that the annual income received by the Prince of Monaco from Monte Carlo is $100,000,000. In typesetting the paragraph an extra cipher crept into this sum. The amount should have been stated as $10,000,000 for the past year—about $4,000,000 as income to the Prince, and the rest as contributions by the Monte Carlo concessionaires toward the upkeep of the Principality of Monaco.

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